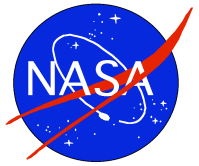
Section 5.6

GBM Instrument Operations Center

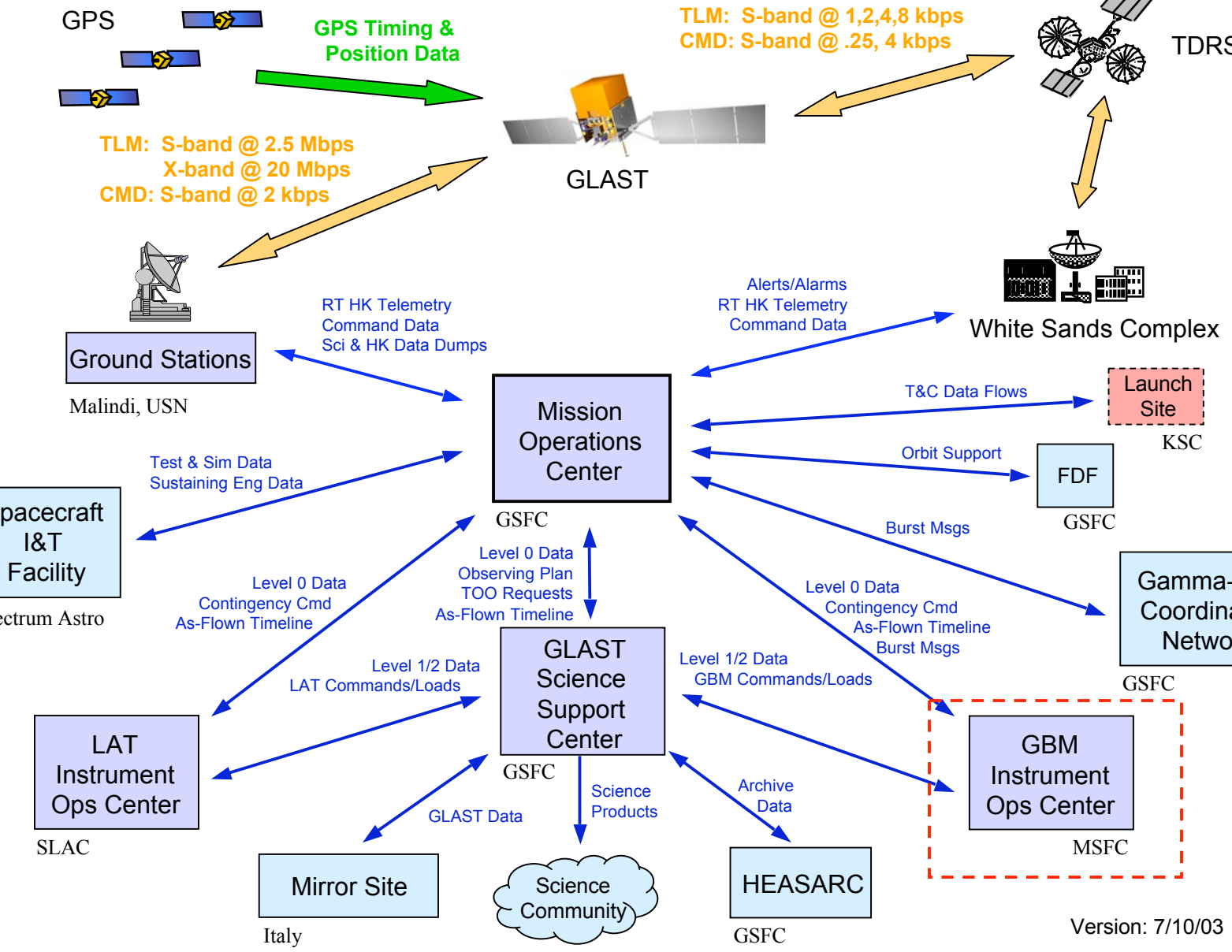
Bill Paciesas
GBM Operations Manager

Outline



- ***Overview***
- ***Key Requirements***
- ***GIOC Concept***
- ***GIOC Heritage***
- ***GIOC Development***
  - *Instrument Operations & Data Analysis (IO/DA) Software*
  - *Development Organization, Roles & Responsibilities*
  - *Staffing*
  - *Software Development Process*
  - *Documents & Deliverables*
  - *Schedule*

Ground System Architecture

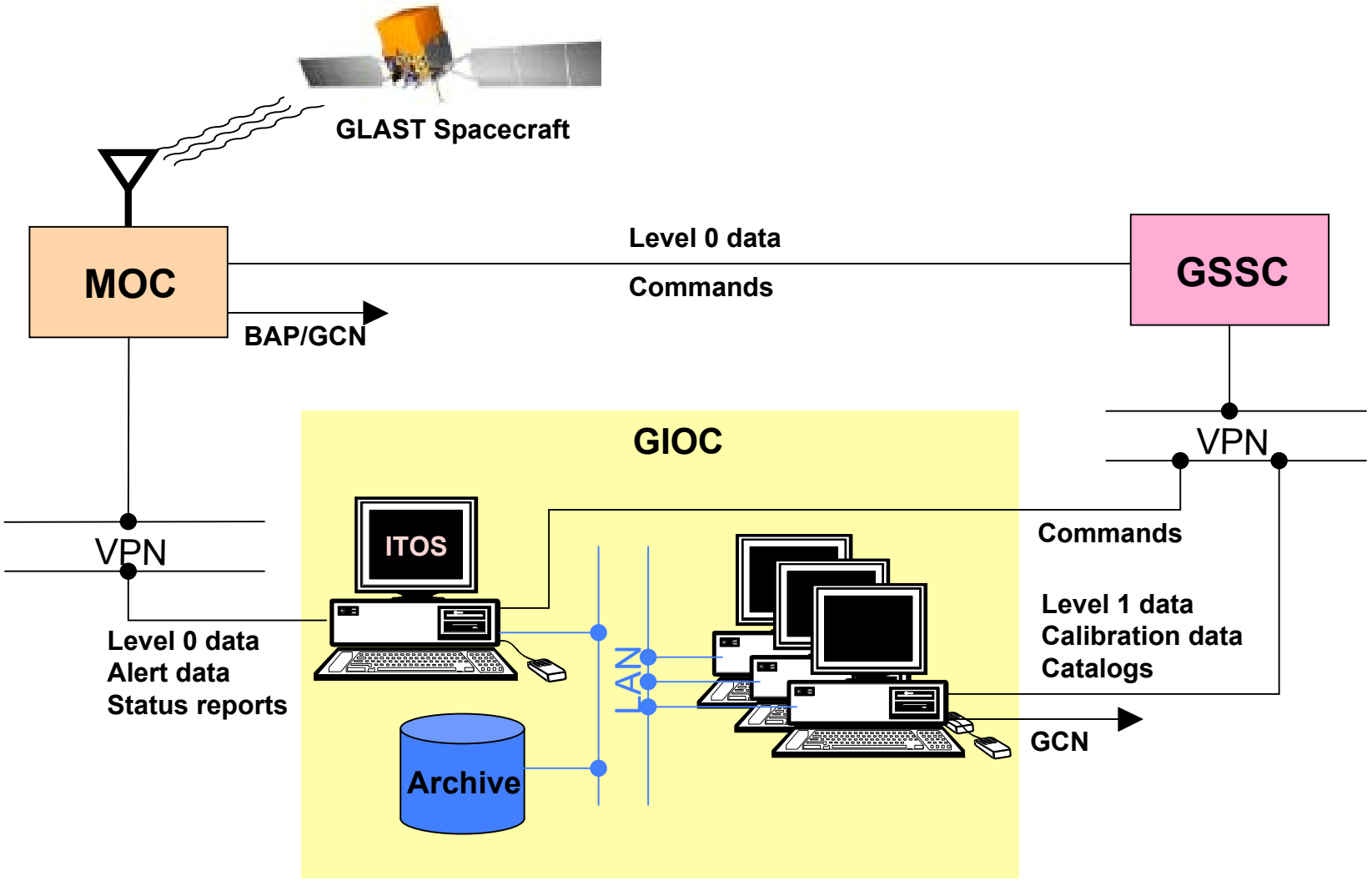


Version: 7/10/03

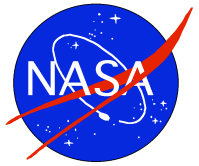
GBM IOC Overview

- ***Functions***
  - *Generate, archive & distribute level-1/2/3 data products*
  - *Instrument commanding*
  - *State-of-health monitoring*
  - *Support instrument calibration*
  - *Validate flight data*
  - *Quick-look science data analysis*
  - *Generate rapid science alerts*
  - *Refine burst alert processing*
  - *Maintain flight software development system*
  - *Maintain IO/DA software, including Burst Alert Processor*
- ***Implementation***
  - *Located at NSSTC, Huntsville, AL*
  - *Cluster of COTS workstations*
  - *Normal staffing weekday prime shift*
  - *Supplemental operations at Max Planck Institute (MPE)*
  - *Basic data receipt, data reduction & state-of-health monitoring run autonomously*
  - *GSSC back-up for level-1 processing*

GBM Instrument Operations Center

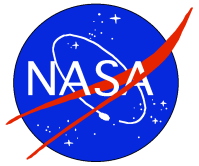


Key Requirements (1)



- ***Instrument Health & Safety Monitoring***
  - *Generate Summary Reports*
  - *Maintain Operations Log*
- ***Instrument Commanding***
  - *Develop Command Loads*
  - *Schedule Commands*
  - *Develop Contingency Procedures*
- ***Data Processing***
  - *Generate & Archive Level 1 Data Products*
  - *Generate & Archive High-Level Science Products*
  - *Support Data Processing/Reprocessing Rate > 2 X Orbit Average Rate*
  - *Maintain Archival Data Storage Capability > 4 TB*

Key Requirements (2)



- ***Generate Ground-Based Burst Locations (Rapid & Final)***
- ***Respond to GBM Trigger Alerts***
  - *Perform Standard Analysis*
  - *Generate GCN messages as appropriate*
- ***Monitor Instrument Calibration***
  - *Process & Archive Test & Calibration Data*
  - *Monitor Detector Gain & Resolution*
  - *Generate Detector Response*
  - *Deliver Calibration Data to GSSC*
- ***Support Science Data Analysis***
  - *Develop & Maintain Data Analysis Software*
  - *Deliver Data to MPE*
  - *Deliver Data to GSSC*

Key Requirements (3)

- ***Maintain Flight Software***
  - *Validate Flight Software Loads*
  - *Generate Flight Software Uploads*
  - *Maintain Flight Software Simulator*
- ***Perform Operations***
  - *Schedule Routine Operations*
  - *Support Capability for On-Call Operations*
  - *Support Special Operations During On-Orbit Activation*
  - *Provide Capability for Autonomous Data Receipt*
- ***Provide Data to & Acquire Data from GBM Mirror Site***
- ***Evaluate and maintain the quality of science data***
- ***GIOC available for autonomous data transfers from the MOC > 90%***
- ***Connect to Other Operations Elements by Secure Network***
- ***Verify/Validate Data by Visual Inspection & Analysis***

GIOC Concept (1)

- ***Cluster of COTS PC workstations***
- ***Located in room 2101 of the NSSTC***
- ***Normal staffing: single prime shift on weekdays***
- ***Routine Operations***
  - *Automated processing and production of level-1 data products*
  - *Identify out-of-limits conditions or other anomalous GBM operation*
  - *Produce routine data plots & status reports*
  - *During prime shift, operations personnel review the data and adjust instrument configuration, calibration tables, or software as needed*

GIOC Concept (2)

- ***Operations during non-prime shift***
  - *Basic data receipt, data reduction & state-of-health monitoring run autonomously*
  - *System status accessible by secure remote connection*
  - *GIOC staff person always on-call to be paged automatically in case of anomaly detected by MOC or GIOC automated processing*
- ***Gamma-ray Burst Special Processing***
  - *MOC automatically produces & disseminates refined GRB locations using Burst Alert Processor (BAP) provided & maintained by GIOC*
  - *GIOC produces & disseminates additional refined locations using interactive GRB location software*
- ***GSSC Functions as Back-Up for GBM Level-1 Data Processing***

GIOC Concept (3)

- ***Supplemental GBM Operations at Max Planck Institute, Garching, Germany (not needed to meet requirements – adds value to science)***
  - *Seven-hour time difference between Huntsville & Garching allows extension of prime shift for staffing*
  - *Perform state-of-health monitoring & quick-look GRB analysis*
- ***GBM Flight Software Maintenance***
  - *DPU-Test & Evaluation System (with one of the DPU engineering units installed) becomes flight software simulator*
  - *Maintained by the GIOC for the duration of the GLAST mission*
  - *Use in anomaly investigation and flight S/W maintenance*

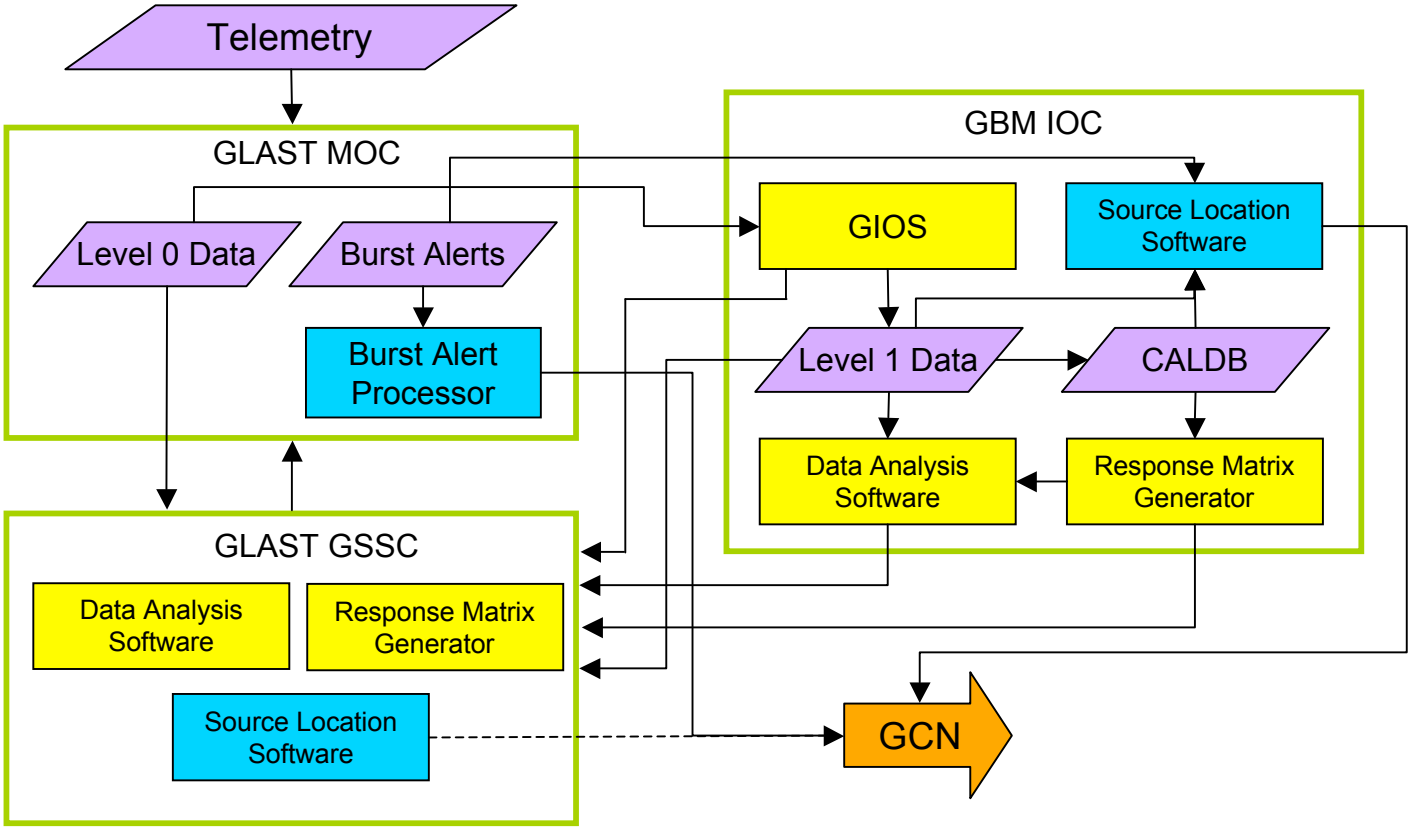
GIOC Heritage

- ***Compton Gamma Ray Observatory Burst and Transient Source Experiment (BATSE)***
  - *Operated successfully for 9 years*
  - *Most GBM team members also worked on BATSE*
  - *GBM gamma ray burst operations similar to BATSE*
  - *Many similarities in software and data analysis*
    - *Burst location technique*
    - *Spectral deconvolution technique*
  - *Significant software reuse (RMFIT)*

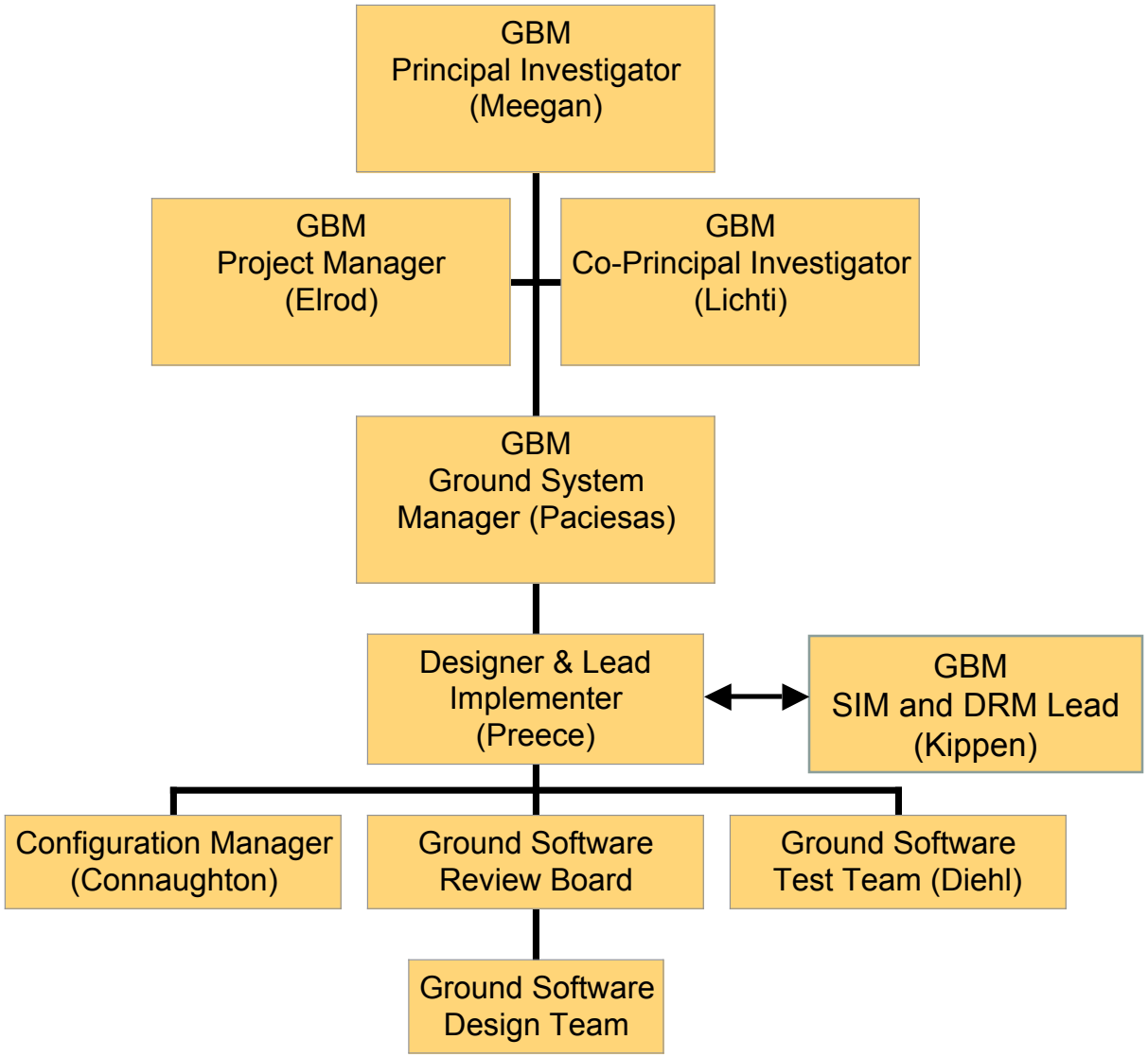
Instrument Operations & Data Analysis (IO/DA) Software

- ***Software to control GBM testing, checkout and instrument operations***
- ***Integration and Test software***
  - *Some components of the IODA software are required to support GBM Integration and Test*
- ***Software at GBM IOC: GBM Instrument Operations Software (GIOS)***
  - *GBM commanding, data processing & archiving, detector monitoring*
  - *Some functions to be delivered to GLAST GSSC and MPE*
- ***Burst Alert Processor (BAP)***
  - *resides at MOC, GIOC*
- ***GBM Data Analysis Software (GDAS)***
  - *Cosmic event global properties: Location, Duration, Flux & Fluence*
  - *Spectral Analyses*
  - *Not restricted to run on GIOC hardware: broad scientific usage*

GBM IO/DA Data Flow



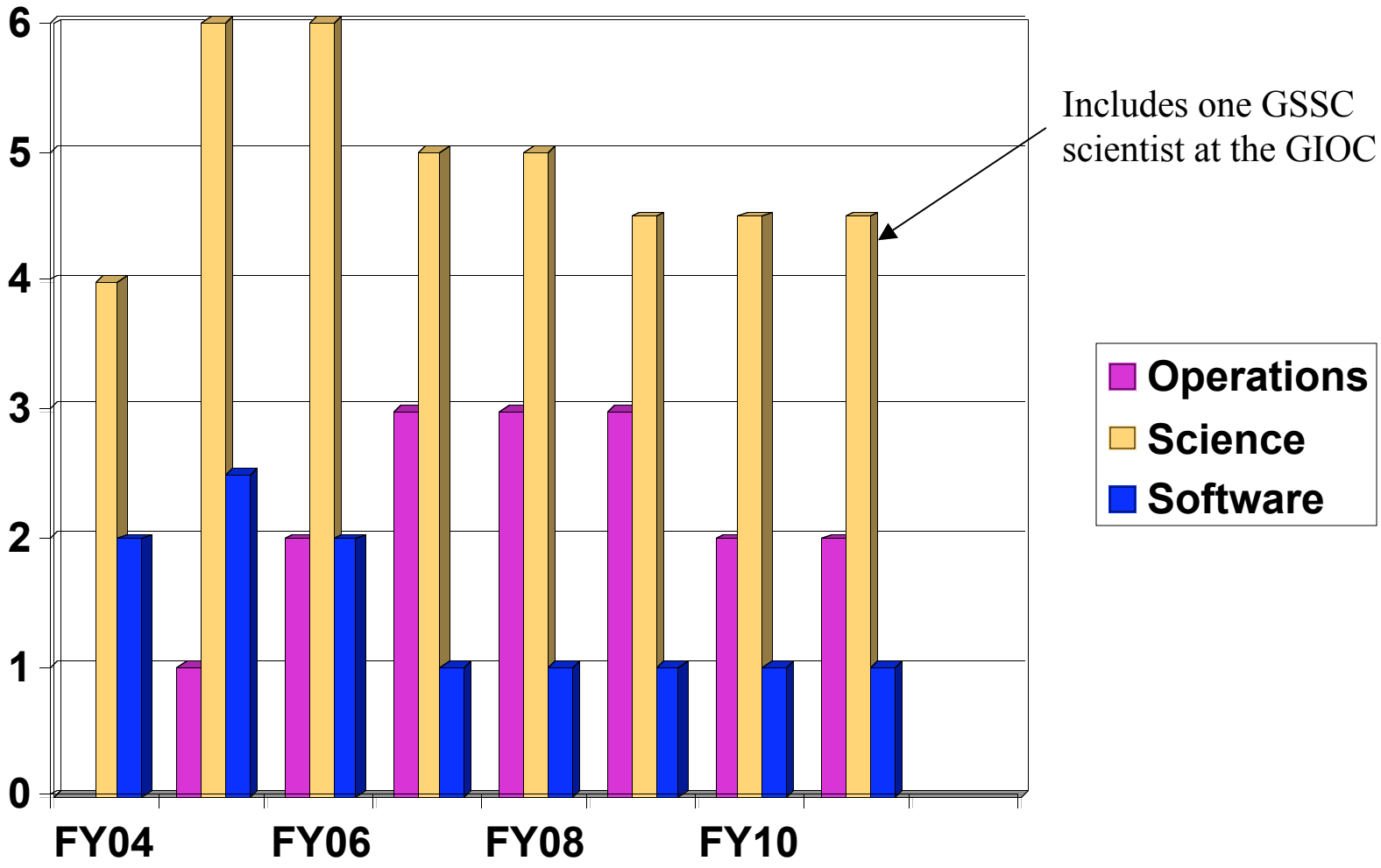
GIOC Development Organization



Roles & Responsibilities

Team or Individual	Tasks
GBM Project Manager (Elrod)	Overall Experiment Management
GBM PI (Meegan)	Overall Scientific Management
GBM Ground System Manager (Paciesas)	Management of Ground System Development & Operation
Ground Software Review Board (Chair – Preece)	A subset of the Ground Software Design team with decision-making authority
IO/DA Software Lead (Preece)	Designer and Lead Implementer of the Ground Software Development
GBM SIM and DRM Lead (Kippen)	Designer and Lead Implementer of the GBM Simulation and Detector Response Software
Configuration Manager (Connaughton)	Assure that all software deliverables are archived, properly identified, and retrievable
Ground Software Design Team (Chair – Preece)	Review the design, both at informal walk-throughs, and as presented in the detailed design document.
Ground Software Test Team (Chair – Diehl)	Review the Ground Software Test Plan. Develop test procedures. After review, perform the tests and prepare the test reports.

GIOC Staffing



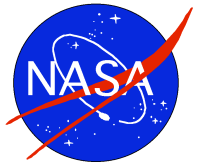
Technical Process Plan

- ***Process Model:***
  - *Preliminary Design of each Build → Ground Software Lead*
  - *Detailed design → Ground Software Lead*
  - *Periodic design walk-throughs → Ground Software Design Team*
  - *Informal code and test → Ground Software Lead*
  - *Coding → Ground Software Lead*
- ***Methods, Tools & Techniques:***
  - *Software requirements analysis → GBM IO/DA Functional Specifications*
  - *Ground Software design → GBM Ground Software Design Specification*
  - *Initial Development → GBM EGSE (SIIS, running ASTRO-RT)*
  - *Final delivery Ground Software → ITOS*
    - ***Relocatable Software Components***
    - ***Modular objective elements & Standard interface definitions***
- ***Infrastructure Plan:***
  - *Hardware OS: commercially-available UNIX (e.g.: Red Hat Linux)*
  - *Development tools → standard distributions of Linux*

Supporting Process Plans

- ***Configuration Management:***
  - *GBM Ground Software configuration management BitKeeper*
    - ***Each component: separate Version Number***
    - ***Version number displayed generated output or data product***
    - ***GBM Ground Software Documents GBM Configuration Manager***
  - *Archiving of Software builds: 2 copies by CD-R*
  - *Changes to baselined products:*
    - ***Software Problem Report***
    - ***Software Review Board***
    - ***Configuration Manager baselines and maintains each new version***
- ***GBM Ground Software Coding Standards:***
  - *Subset of Indian Hill C Style (L. W. Cannon, et al.)*
  - *C or C++ will be used where appropriate*
  - *Other software languages may be imposed by circumstances (ASTRO-RT & ITOS)*
    - ***Coding Standards will be applied as appropriate***
  - *Reused and tested code need not be changed to accommodate standards*

Supporting Process Plans (Cont'd.)



- ***Verification and Validation, GBM Ground Software:***
  - *Verification testing ⇨ GBM Ground Software Test Team*
    - ***Independently ⇨ MPE GBM co-investigators***
    - ***GBM IO/DA Functional Specifications ⇨ Verification Test Procedures***
    - ***Initial verification testing ⇨ Hardware supporting GBM EGSE***
  - *Validation ⇨ Final GIOC hardware configuration*
  - *Revisions from verification ⇨ Software Problem Report*
    - ***Ground Software Lead: SPR ⇨ GBM Ground Software Design Team***
    - ***Suggested Resolution ⇨ SRB***
    - ***SRB ⇨ IO/DA Lead for implementation, revisions & retesting***
- *Documentation review ⇨ GBM Ground Software Design Team*
- *Reviews and Audits:*
  - *Monthly: GBM Ground Software Lead ⇨ GBM Ground System Manager*
  - *IOC PDR & CDR*
  - *Informal: GBM Ground Software Software Design Team*
  - *By Request: GBM PI & Ground System Manager*

GBM Ground Software Documents

Software Document	Baselined By	GIOC PDR	GIOC CDR	Responsible Organization
GBM Ground Software Development Plan	PROJ	Baseline		UAH
GBM IO/DA Functional Specifications	PROJ	Baseline		UAH
GBM EGSE Functional Specifications	PROJ	Baseline		UAH
GBM Simulation and Detector Response Software Functional Specifications	PROJ	Baseline		LANL
GBM Ground Software Users Manual	SRB		Prelim.	UAH
GBM Ground Software Executable(s)	SRB		Prelim. Design	UAH
GBM Ground Software Test Reports	SRB			UAH

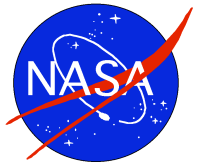
PROJ – GBM Project
SRB – GBM Software Review Board

LANL – Los Alamos National Laboratory
UAH – University of Alabama in Huntsville

Upcoming Events

- ***GBM Ground System CDR***
  - *October 30, 2003*
- ***GBM System CDR***
  - *January 15, 2004*
- ***GBM Pre-System Environmental Review***
  - *January 12, 2005*
- ***GBM Pre-Ship Review***
  - *August 2, 2005*

GBM Ground Software Deliverables



Item	Date	Milestone
Build 0.1: Command and Telemetry Database	*Oct. 22, 2003 (GBM GS CDR)*	*To support MSFC test of GBM Engineering unit*
GIOS Release 1	*Oct. 1, 2004*	*GBM Pre-System Environmental Review*
Build 1.1: Command and Telemetry Database	*Dec. 1, 2004*	*Ground Readiness Test (GRT) 1*
Build 1.2: Command and FSW Load Handling	*Apr. 1, 2005*	*GRT 2*
Build 1.3: Burst Alert Processor	*May 31, 2005*	*GRT 3*
GIOS Release 2	*June 15, 2005*	*GBM Pre-ship Review*
Build 2.1: CALDB & Trigger Data	*Sept. 1, 2005*	*GRT 4*
Build 2.2: FSW Upload & Archive (Launch Ready)	*Nov. 15, 2005*	*GRT 5*
Build 2.3: DRM Generator	*Dec. 1, 2005*	*To support data challenge 3*
GIOS Release 3	*June 1, 2006*	*GRT 7*
Build 3.1: DRM Database	*Nov. 1, 2006*	*To support phase E*

GIOC Software Requirements by Release

- ***GIOS Release 1***
  - *Command Load Handling*
  - *SC Position and Orientation History*
  - *Packet Data Handler: Level 0 -> Level 1, Instrument Status*
  - *Quicklook data Display*
- ***GIOS Release 2***
  - *Burst Alert Processor*
  - *FSW Maintenance*
  - *Instrument Status Alerts*
  - *Calibration Archive*
  - *Trigger Data Packager*
- ***GIOS Release 3***
  - *Trigger Catalog (Level 2)*
  - *GRB Flux, Fluence, Duration and Location*
  - *Spectral Analysis Final*

GIOC Development Schedule